

XII. *Further notes on recapitulatory attitudes in Lepidoptera.* By T. A. CHAPMAN, M.D.

[Read October 3rd, 1917.]

I HAVE made a few more observations on the methods followed by some Lepidoptera in passing from the attitude of drying their wings after their expansion to their ordinary attitude of rest. The subject is interesting from any point of view, and especially as it points to each species that has a special resting attitude adopting during this period certain positions that are actually, or in some degree recall, the ordinary resting attitude that is not theirs but that of the group to which they belong, or that is most frequent in Lepidoptera.

I have only had opportunity to observe three more species of butterflies. They agree with those reported on last year, in making certain opening and closing wing movements, not after the wings are dry, but during the process of drying: so far as my few observations go nothing of this sort occurs in the Heterocera.

In *P. rapae* this was seen to suggest an effort, which the limpness of the undried wings prevented being successful, to spread the wings flatly, as in the resting attitude of so many Lepidoptera. The other species noticed had similar alternations of opening and closing the wings, but through a much smaller angle that would not suggest an effort to extend them flatly, but for the fact that they were obviously of the same character as in *P. rapae*. Though this curious habit may have some other meaning, none has occurred to me but that mentioned in my previous paper.

With regard to the Heterocera observed, the Geometers follow broadly the same procedure as did those reported in the previous paper, and suggest that the habit they exhibit will obtain in all similar Geometers, that is, similar in having resting positions other than the typical deltoid one. My examples come from each of the three largest sub-families of our British Geometers, so that the habit is in no way of classificatory value. This conclusion is confirmed by finding that precisely the same reminiscence of the typical resting position occurs in the quite unrelated *F. falcataria*.

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The detailed notes taken minute by minute during the observations, as I gave them in my first notes on this subject, seem of little value, except as proof that the observations actually were made, so I do not append them, but rather describe the general succession of events in each species, instead of leaving them to be worried out of memoranda made hurriedly during the observations, and not perhaps easily understood, owing to their abbreviated nature, except by myself.

The species observed were —

*P. brassicae*. The wings expand to a position the same as the normal resting position, that in which most *Lepidoptera* dry their wings. Almost as soon as one can say expansion is completed, the wings are opened apart to a position in which the fore and hind wings being together, the mid-costae are 8 to 12 mm. apart, and the apices 3 to 8 mm., so that the attitude corresponds to that which in *P. rapae* I have described as bell-shaped: but the separation is so slight in comparison that this attitude would not in *brassicae* suggest any resemblance to the outline of a bell. It is, however, essentially the same, in that the wings being limp the apices approach each other, more than the mid-costae, and are in fact 3 to 8 mm. apart instead of 12 to 20, as they would be if the wings were stiff. They maintain this attitude for about thirty-five seconds and then close, so that the costae are in contact to within 4 mm. of the thorax. They remain so for about forty-five seconds and are again opened to the open position. This alternation is repeated about fourteen or fifteen times. The actual opening and closing takes about ten seconds. The period during which the wings are open is very similar to that during which they are closed, viz. about thirty-five to forty-five seconds. These vary a little in the same specimen and between different specimens, but only by a few seconds. I ought to have said that when open there is the variation of 8 to 12 mm. at mid-costa in different specimens, not in the same specimen, and that 8 mm. at mid-costa corresponds to 3 at apices, 12 mm. to 8 at apices. At the fifth or sixth opening the hind-wing tends to open a little before the fore-wing, separating from them by a millimetre or two in the process. About the seventh or eighth opening, the wings are seen to be stiffer than at first, and the apices are as wide apart as the mid-costae. About the tenth the apices open wider than the mid-costae,

the wings being stiffer and holding themselves straighter. About this time the hind-wings tend to be a little separate from the fore-wings when open. Then the fore-wings open but little and the hind-wings rather more. Gradually by about fourteenth opening the hind-wings only open, or the fore-wings hardly perceptibly; gradually the separation of the hind-wings diminishes, and somewhere about the sixteenth to twentieth alternation one may say the process has finished. When closed, the wings at first close very close up to the thorax, their limpness causing no resistance by the further portion of the wings to this approximation; as the wings get stiffer they do not close so far up, only sometimes for a third or half-way from the apex. Later, when the final resting attitude is assumed, they close further up, nearly as far as at the first closing. One or two specimens opened more than the usual 8 or 12 mm., one as much as 20 mm. and might fairly be described as in the bell attitude.

Throughout the process the butterfly at intervals, without reference to the wings being opened or closed, makes a shivering movement, at others rocks to and fro a little—this more frequently on closing the wings, and more frequent in later stages—and makes a few fluttering movements of the wings of an amplitude of about 0.5 mm. All this time the antennae are well separated, much as in the mature butterfly, but are directed slightly behind a line at right angles to the line of the body, which is reached by them about the time the wings finally close, but do not reach the final somewhat correct position till an hour or more after; their advance to this position is gradual and imperceptible. The hind-wings have the costae nearly level with those of the fore-wings when mature, during the opening and shutting movements they are usually a millimetre or two behind.

We have here, though less obvious, just as in *P. rapae*, an effort to assume the Lepidopterous resting attitude, *i. e.* with the wings flat, but as in *P. rapae* it occurs not after the wings are dry but during their drying, being as it were pushed backwards in the ontogeny.

*Pieris napi*. The process in *napi* is almost intermediate between those of *rapae* and *brassicae*, the bell attitude results from the wings being depressed to an angle of about 45° (90° between the opposite wings) instead of the 90° of *rapae* or the 15° or 20° of *brassicae*. The details differ a little, but hardly to a degree worth full description.

*Chrysophanus* dispar, var. *rutilus* emerges about 9.30 a.m. Wings expand very rapidly in from six to ten minutes, they expand to butterfly resting attitude, *i. e.* wings closed dorsally. There then begins a succession of what must be called opening and shutting the wings, though the opening only amounts to a separation of 2 or 3 mm. When closed, the wings (costae) are in contact for four-fifths of their length. when open, though the wings are elsewhere separated, the apices may in some cases meet. They remain closed for about thirty seconds and open for forty-five seconds, but the time varies a little, for about sixteen times in twenty minutes and then for several times more, but so slightly as to be almost doubtful. settling down to the distal two-thirds of the wings touching at the end of half an hour. About the middle of the period the hind-wings open from the fore-wings, so that their tips are 6 or 7 mm. apart during several periods of being open. Various minor details as to movements of proboscis and positions of antennae are not perhaps worth reporting.

*Smerinthus populi* and *ocellatus* only afforded me three observations; they have a habit, very trying for this purpose, of emerging hardly before and usually a good time after midnight. They expand the wings into the drying attitude, and then gradually and imperceptibly open them, during about half an hour, to the ordinary resting attitude for the fore-wing; the hind-wing is then only partially advanced to show its costa, not more, in fact, than is compelled by its greater width; they project about 7 mm., and it is some time before they advance to show nearly double this width.

It cannot be said, so far as my meagre materials justify, that these species show any attempt to exhibit the normal Lepidopterous resting position.

*Falcaria falcataria* follows very closely the habits of the Geometers, *Ephyras*, *Acidalias*, etc. It emerges about 5 to 5.30 a.m., rarely or never after 6.30. It expands the wings under an hour, then throws them back into usual drying attitude with a little sudden jerk, remains so for perhaps forty minutes, then gradually lowers them, *i. e.* with no sudden jerk to flat attitude, with inner margins against body, *i. e.* to normal Geometer resting attitude. Some specimens advance the fore-wings gradually and very slowly to the resting attitude of the species, *i. e.* exposing much of the hind-wings; others remain in the triangular position

much longer, probably till period of evening flight in most cases.

*Phalera bucephala*. The resting attitude in most *Noto-donts* is the normal one with the wings in pent-house position. In *bucephala* this is, one may say, exaggerated, so that the wings curl round the body in such a way that the costae of the fore-wings approach each other beneath the insect, and the apices are never more than a few millimetres apart, and may touch if the object on which the moth rests permits or favours this.

The wings expand to a position in which their surfaces form a flat arch over the dorsum, then they are thrown back in the usual way into butterfly attitude. They remain so, drying, for half an hour, and are then deflexed to about the arched position to which they expanded, the surfaces of the fore-wings being at an angle of about  $110^\circ$ , the inner margins in contact and the apices 25 mm. apart. In about an hour the angle of the wing surfaces to each other is  $90^\circ$ , and the apices are only 16 mm. apart. The wings have already a little curvature. In another hour the tips are only 9 mm. apart, and in successive hours they are noted as 6 mm., 4 mm. and 3 mm. apart. Three hours more they are observed to be touching; this movement, from the rather flat pent-house position, to that of the wings being so curled round the body, is gradual, with no actual movement observed at any time, and would appear to depend on the gradual acquirement by certain wing muscles of the necessary tonicity.

*H. abruptaria* emerges in the afternoon about 4 or 5 p.m. A specimen kept the wings in ordinary Geometer position (triangular) from 5.30 to 7.30, though disturbed once about the middle of this period. Ten minutes later (7.40 p.m.) it had assumed the ordinary resting attitude of the species with the fore-wings advanced.

*T. consonaria* emerges about 4 p.m. An hour later the wings are expanded and the butterfly attitude taken, and in another half-hour they are deflexed to the ordinary triangular Geometer resting position, which is maintained for at least two hours and probably as a rule till the time of flight, but on earlier disturbance the usual resting position with advanced fore-wings is assumed on resting again. I did not ascertain after how short a period in the triangular position this would occur.

In *Tephroclystis isogrammata* the wings were maintained

in the drying (butterfly) attitude only twelve minutes, and were then placed in the Geometrid (deltoid) position. Being disturbed some five minutes later, so that it ran two inches, it settled again in the same attitude. The two costae form an angle of about  $100^\circ$ ; an hour later it was about  $150^\circ$ , and in another hour the usual resting position was attained, with costal angle of  $190^\circ$  to  $200^\circ$ , i. e. with the wings forward of having the costae in line.

*Selenia illustraria*. This species differs a good deal from *S. illunaria* in its methods of proceeding from wing expansion to the normal resting position. Though in a warm room, specimens would occasionally be more than half an hour after emergence before any sign of the wings expanding could be detected. The wings then expanded rather rapidly, taking, however, usually about or a little over thirty-five minutes to expand. When expansion is completed the wings hang backwards, but only the tips of the fore-wings touch each other, not indeed always doing so. Then gradually the wings approximate to the butterfly attitude, that is, closely pressed together dorsally, so that the costae are coincident for their distal halves.

The moth selects a vertical or, if possible, a slightly overhanging position in which to expand, so that now they hang downwards, more or less, whilst in this backward position. A special feature is that this dorsal position is gradually attained by quite imperceptible movement, and this peculiarity continues throughout the whole evolution from the beginning of expansion to the attainment of the normal resting position; there is no sudden movement as is so common, either of throwing the wings back, or assuming the resting position. This closing backwards is attained in ten or fifteen minutes after expansion is completed; the wings are kept so for about twenty minutes and then are gradually separated in a minute or two till the costa of fore-wings are separated to an angle of  $10^\circ$  or  $15^\circ$ ; the separating movement is continued in the same gradual, hardly noticeable manner, till in about two more minutes the angle is  $60^\circ$ , in two more  $90^\circ$ , and in two or three more finally  $100^\circ$  or  $110^\circ$ . Usually the process is rather slower, and varies a good deal in its rapidity at different stages. In the position of the moth, gravity no doubt tends to make the wings hang directly backwards; nevertheless, the position of the wings at this stage is with the costae of the anterior wings at an angle with each other of about



120°, and of the flat surfaces of the wings of about 140°; the costae not being so far advanced as to be in a plane transverse to the line of the insect body, but behind this in a plane that slopes backwards from it at a considerable angle. This position, which appears to represent the memory of the normal (triangular) resting attitude of *Geometers*, may last about thirty minutes, and in another thirty minutes the wings close again dorsally to a costal angle of about 45°. At this point the costae of the fore- and hind-wings on either side are nearly coincident.

In the same gradual imperceptible way in which the other movements occur, the fore-wings advance from the hind-wings. Measured from costa to costa at the post-discal line it takes about two hours for the fore-wings to be 3 mm. in advance of the hind-wings, the fore- and hind-wings being still in the same plane. Then, still very gradually, the fore-wings assume the curious bend in a line below vein 2 that characterises the ordinary resting attitude of the species, the inner part of the wing being in the same plane with and close against the hind-wing, the greater (costal) portion being raised at a considerable angle. At the end of another hour one may think this attitude is attained, at the end of two one has no doubt it is. All the progress and the movements involved are so gradual and imperceptible that it is difficult to divide them into stages and say when each is complete.

*Illustraria* emerges in the morning about 6.30 to 7.30 a.m.

*Ennomos lunaria*. The wings are thrown back when expanded, and some ten minutes later and when apparently dry are opened gradually, so that in about six minutes they nearly approach a flat position, instead of 180° (flat), between the two fore-wings they are about 160° or 170°. In some ten minutes the angle diminishes to that of normal resting, perhaps 80°, but there is still no angulation of fore-wing, and the hind-wing is only 3 or 4 mm. behind fore-wing. The complete resting attitude with fore-wing advanced and with the longitudinal fold is not attained till an hour or two later. I see that in one specimen I noted the wings were opened till quite flat; in another they did not get quite as far, but I did not note the angle. The costae of fore-wings made an angle of 90°, but the wing surfaces were much more.

*Fidonia pinivaria* emerges 6 to 8 a.m. The wings expand

to the dorsal (butterfly) position in about twenty minutes; in about ten minutes more they are gradually separated, so that in two or three minutes the wings are separated so that the apices are some 18 mm. apart, the angle between the wings being about  $40^\circ$ . They remain thus for about six or seven minutes, the wings appearing to be quite dry and stiff. They then gradually close, at the rate of about 1 mm. (for each wing) a minute, and in ten or twelve minutes the butterfly attitude (the normal resting attitude of *pinaria*) is reached, to appearance, but they are not tightly closed for ten or twenty more minutes. The whole process is gone through very rapidly (compared with most other species). After the wings are dry they are separated, but not widely, so that the reminiscence of the flat deltoid attitude, though still present, is comparatively brief and slight. The process reminds one of that obtaining in the butterflies, but the important difference is that it takes place after, not during drying; also, of course, it is one, not a succession of movements.

*S. illunaria* and *F. pinaria* both have a normal resting attitude similar to that of the butterflies, with the wings raised over the back; but the reminiscence of the ordinary Geometrid attitude which they display, in the interval between the completion of the drying of the wings and the assumption of their resting attitude, two attitudes that are identical and that one would expect to find continuous, is curiously different in the two species. In both species, however, the reminiscence is there.

In the *Études de Lépidoptérologie Comparée*, Fasc. V (II), p. 115, Mr. H. Powell records how *Syrichthus mohammed*, Obthr., having expanded its wings in the closed ("butterfly") attitude, depresses them to the Geometrid or triangular position, and gives photographs on Pl. H<sub>j</sub>, Fasc. VI and Pl. H<sub>b</sub>, Fasc. V (II) and of *S. proto* on Pl. 27, Fasc. VII. He says this position is kept for only a short period. In complete repose the wings are closed in butterfly attitude; when basking, the depressed wings have the costae at right angles to the body; when resting briefly the fore-wings are well raised. This merely summarises a valuable demonstration that the recapitulatory attitude is very manifest in *Syrichthus*. In this habit the "Skipper" appears to be nearer the *Heterocera* than to the butterflies.